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IS : 8592 - 1977

Indian Standard
METHODS FOR
IDENTIFICATION OF BRUSH FILLING
MATERIALS OF ANIMAL ORIGIN

UDC 687-9-13 : 543-061



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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Price Rs 7-00

GN. A

March 1978

Indian Standard

METHODS FOR IDENTIFICATION OF BRUSH FILLING MATERIALS OF ANIMAL ORIGIN

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Indian Standard

METHODS FOR IDENTIFICATION OF BRUSH FILLING MATERIALS OF ANIMAL ORIGIN

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 25 August 1977, after the draft finalized by the Brushware Sectional Committee had been approved by the Chemical Division Council.

0.2 Brush filling materials may be classified into two different categories, namely, man-made or synthetic and natural, that is, obtainable from animal sources.

0.3 Brush filling materials of animal origin are collected from different parts of the animals like the pig, the horse, the goat, the cow, etc. According to the existing trade practice, the natural wiry, stiff and erect hair obtained from the back and neck of pigs, hogs and wild boars are called 'bristle'. The term 'hair' is used to denote hair procured from bodies or tails of other animals. Hair from all animals do not interest brush-makers. Hair of those animals which are used in the brush industry are horse tail and mane hair, cow tail hair, goat hair, badger hair, kolinsky or sable hair, weasel hair, mongoose hair, deer hair, pony hair, squirrel hair, etc.

0.4 All filling materials obtained from animal sources are composed primarily of keratin. They will behave in much the same way when exposed to the action of chemicals which attack keratin, any difference in behaviour being in degree and not in kind.

0.5 Hair of different animals have their own typical structural formation, some of which are apparent to the naked eye while others are seen or fully revealed by the use of the microscope. Such features as colour, taper, flag, root and softness are of value during primary examination. These are not in themselves proof of identity, and as such, a need was felt for the preparation of a simple method for the identification of brush filling materials of animal origin; particularly for use of purchasing departments like the Railways and the Defence and also for the use of brush manufacturers.

0.6 In preparing this standard, assistance has been taken from the publication 'Brushmaking materials' by F. Kidd, published by the British Brush Manufacturers Association, London.

1. SCOPE

1.1 This standard covers methods for identification of brush filling materials of animal origin only, based on their general properties and physical structure.

2. PHYSICAL STRUCTURE OF HAIR AND BRISTLES

2.1 A study of the structure of hair or bristles is essential for proper understanding of their properties. This may be studied in two ways; a cross-section may be cut, or the specimen may be observed, using a microscope, along its length.

2.2 The following main structural features may be seen in hair and bristles (Fig. 1):

- | | |
|------------------------|--|
| a) Central core | The medulla |
| b) Outer skin | The cuticle or epidermis |
| c) Intermediate region | The cortex which will contain all or most of the pigment granules which give the material its natural colour |

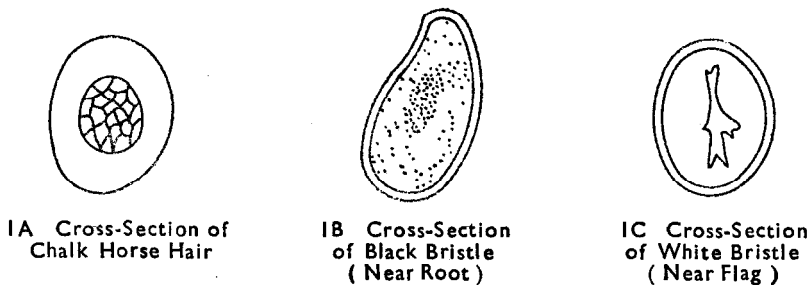


FIG. 1 STRUCTURAL FEATURES IN HAIRS AND BRISTLES

2.3 All cross-sections of animal hair shall always show two of the three features. In some cases, the central medulla is absent and in others it is indistinct. In many hair, the cuticle is so thin that it is only apparent when viewed under high magnification. Nevertheless, acuticle is always present.

2.4 Generally the medulla originates as a thin band at the tip which broadens towards the root end and the pattern within the medulla becomes more complex. The medulla of bristle is unique; it is widest at the tip and decreases towards the root end. The structure of any medulla is less compact than that of the cortex. Physically the medulla is not as strong as cortex. The types of medulla are discontinuous, intermediate and

continuous (nodose and homogeneous) (see Fig. 2).

2.4.1 The 'continuous' medulla is a complete ribbon with or without visible internal pattern of cells. This type is sub-divided as follows:

- a) Nodose (Fig. 2C), and
- b) Homogeneous (Fig. 2D).

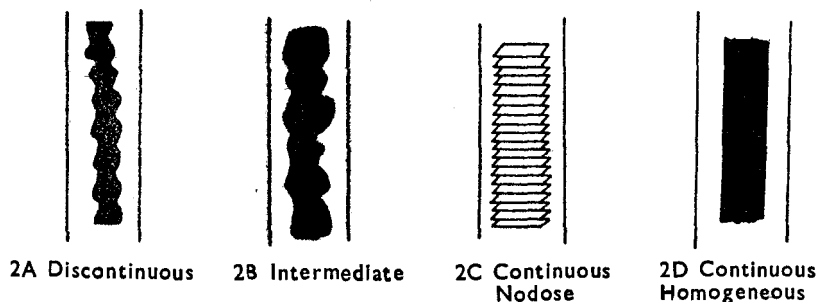


FIG. 2 MEDULLA

2.5 Cortex — The cortex as seen in a cross-section appears as a continuous structure in which are embedded most of the particles of pigment present.

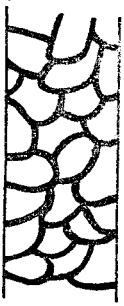
2.6 Cuticle or Epidermis — The edge of the hair when viewed through the microscope is not smooth. The cuticle is in fact composed of overlapping scales. These scales are of various sizes and shapes but they invariably overlap in such a way that the free edges point towards the tip of the hair or bristle. The cuticle is thicker at the tip than it is near the root end. The fact that the free edges of the scales point towards the tip accounts for the well known observation that when bristle or hair are 'rubbed out' they always move towards the root end. Bristle and sable hair have thick cuticles as compared with other hair and so these are considered to be very desirable as filling materials for painters' and artists' brushes.

2.6.1 The scale structure is divided into crenate, ovate, flattened and acuminate (see Fig. 3).

3. DIFFERENTIATION BETWEEN THE FILLING MATERIALS

3.1 Differentiation of Horse Mane Hair from Horse Tail Hair —

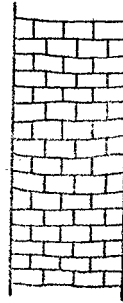
The difference between mane hair and tail hair has never been fully defined once the hair has been cut from the horse, but any sample having an average diameter at the mid-point of not less than 0.14 mm is termed as 'tail' hair. Hair below 0.14 mm diameter may be considered to be 'mane' hair. Mane hair is circular in cross-section and Type 'A' medullae are more common in them than in tail hair.



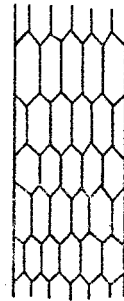
3A Crenate



3B Ovate



3C Flattened



3D Acuminate

FIG. 3 CUTICLE

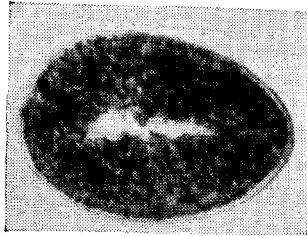
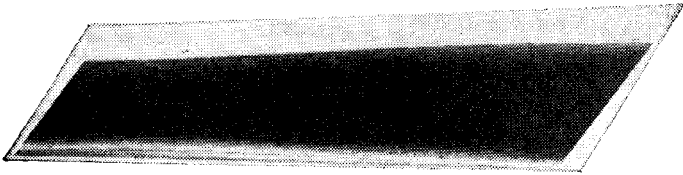
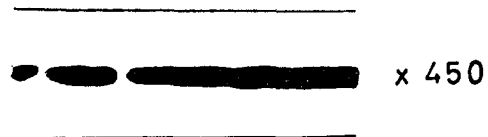


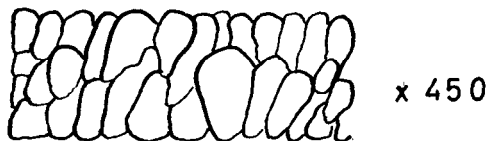
FIG. 4 MEDULLA AND CROSS-SECTION OF BRISTLES



TIP PORTION



UPPER REGION



MIDDLE PORTION

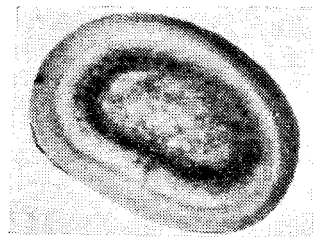
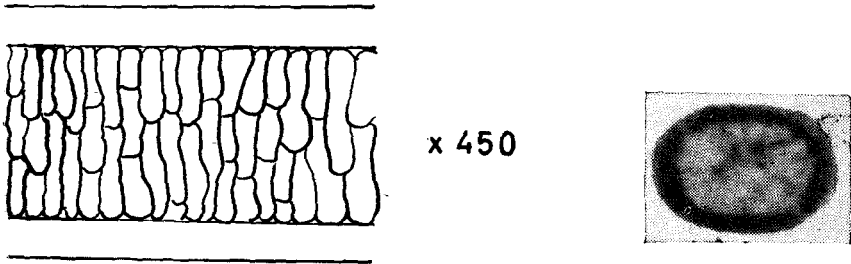


FIG. 5 MEDULLA AND CROSS-SECTION OF SABLE HAIR



MIDDLE PORTION

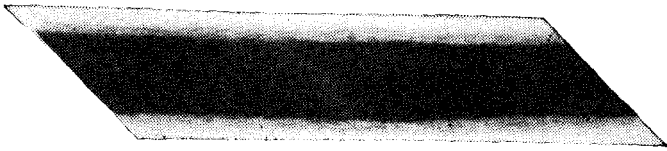


FIG. 6 MEDULLA AND CROSS-SECTION OF SQUIRREL HAIR

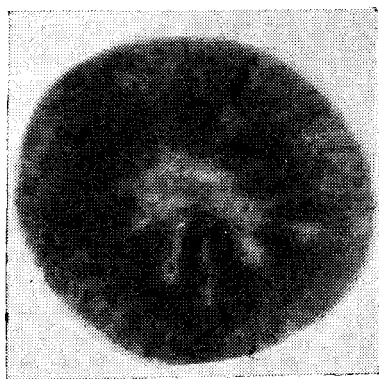
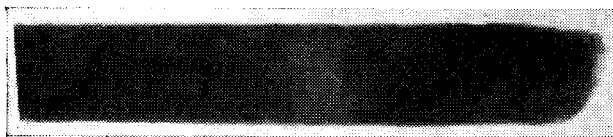


FIG. 7 MEDULLA AND CROSS-SECTION OF HORSE TAIL HAIR

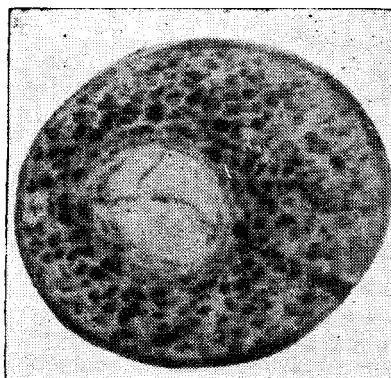
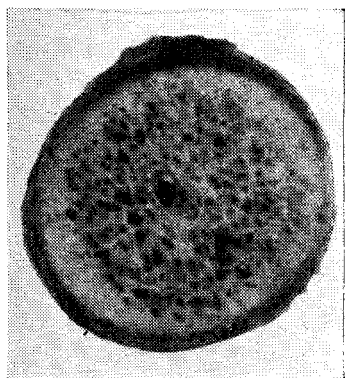
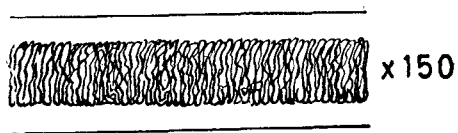
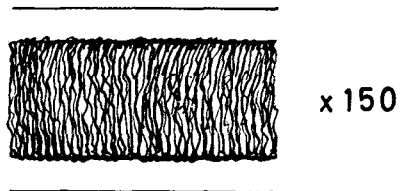


FIG. 8 CROSS-SECTION OF COW TAIL HAIR



UPPER REGION



APPROACHING
ROOTEND



FIG. 9 MEDULLA OF MONGOOSE HAIR

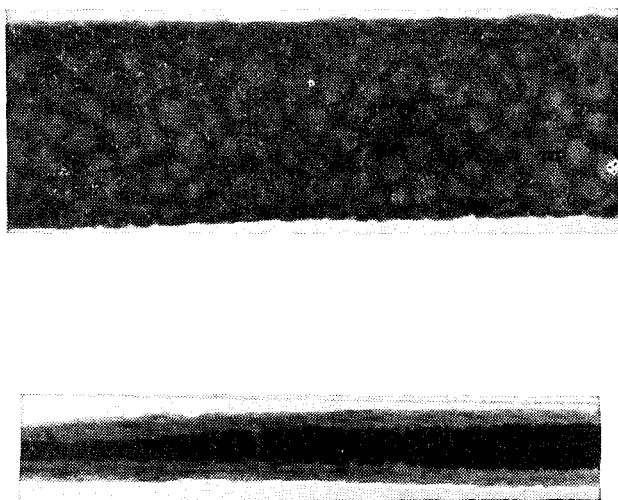


FIG. 10 MEDULLA OF DEER HAIR

3.2 Distinction Between Flagged Hair and Bristle — Normally, there is no 'flag' in any animal fibre other than bristle. A material known as 'flagged hair' is, however, marketed wherein flags have been mechanically introduced. The following tests are employed to distinguish between the two.

3.2.1 If the flagged portion is torn apart, it will be noticed that in the case of bristle, the fibre will split practically throughout its entire length, whereas in the case of 'flagged hair' either of the flagged portions will break away at the point of bifurcation (the point at which the division of fibre commences).

3.2.2 In addition to the above, the microscopic structure of the materials should be kept in mind.

3.3 Distinction Between Animal Hair and Vegetable Fibre — The following practical tests are employed.

3.3.1 Burning Test — Animal fibres burn with a characteristic keratin odour whereas vegetable fibres burn freely and the burning progresses rapidly towards the other end.

3.3.2 Bending Test — When the animal and vegetable fibres are bent, the recovery in original vertical position is much quicker in the case of animal fibres due to their greater resilience.

3.3.3 Tapering Test — When bristles and hair are 'rubbed out', they always move towards the root end.

4. GENERAL CHARACTERISTICS OF THE FILLING MATERIALS

4.1 The general characteristics, both macroscopic and microscopic, of natural filling materials are given in Table 1.

TABLE 1 PARTICULARS OF VARIOUS KINDS OF ANIMAL HAIR AND BRISTLES SHOWING SHAPES OF THEIR STRUCTURAL FORMATIONS

(Clause 4.1)

SL No.	SPECIMEN	MACROSCOPIC		MICROSCOPIC			
		Colour	Structure	Longitudinal Section			Cross-Section
				Cuticle	Cortex	Medulla	
i)	Bristle	a) Black b) Grey c) White	Tapered from root to tip ends Characteristic splitting into bushy ends at the tips, called flag ends The root end is wider in section and has the root sheath	Crenate scale structure throughout their length (Thick cuticle)	Wider in section towards the butt end and diminishing towards the flag end	Widest at the tip and decreases in size towards the root end. Continuous type medulla Microphotos of grey and black bristles are given in Fig. 4	Cross-section at various regions will show that the shape of bristle is oval to irregular along the shaft (as given in Fig. 4)
ii)	Kolinsky and weasel hair (trade name red sable hair)	Dark brown which darkens at the tips	Maximum diameter is in the mid-portion of the hair from where it tapers gradually to the tip giving the long fine points which are a feature of these hair. No root sheath is visible	Thick cuticle	Comparatively wider in section than any other hair. The cortex is wider at the tips than at the butt end Golden yellow pigmented particles visible under high power microscope	Tip, intermediate middle and root continuous nodose (as given in Fig.5)	The hair has got widest cross-section at about the middle region (as given in Fig. 5)

iii)	Squirrel hair	Dark bluish black tip and grey with yellowishness at butt end	Tapered from root to tip. No root sheath is visible	From tip up to the middle portion crenate but changes to ovate near the root end	Feebly developed	At tip discontinuous; from middle to root — continuous nodose (see Fig. 6)	The hair is circular at butt end changing to a dumbbell shape along the hair and then circular again at the tip (see Fig. 6)
iv)	Horse tail hair	a) Black b) White c) Brown	Taper from root to tip is slight but definite. No root sheath or flag end found	Crenate throughout the length but not well defined	Feebly developed	Homogeneous (see Fig. 7)	Feebly developed cortex and other features (see Fig. 7)
v)	Cow tail hair	Pale black, white or brown	Tapered from root to tip and too wavy along its length	Not well defined	Pigmented	a) Non-medullated hair in which the pigment is evenly distributed b) A type with a small central medulla	Hair are almost circular in section throughout the shaft (see Fig. 8)
vi)	Mongoose hair	Pale brownish, striped with darker colour, tips deep brown	Tapered from root to tip ends. Has a pronounced spiral twist along its length	—	Narrower in section than the medulla	Continuous nodose (see Fig. 9)	—
vii)	Deer hair	Brown colour which becomes deep in shade at the tip	Tapered from root to tip ends	Not highly developed	Narrower in section than the medulla	Discontinuous (see Fig. 10) Shows internal pattern of cells of medulla	—
viii)	Goat hair	Pale black, white or brown	Tapered from root to tip end. Lustrous hair with a soft feel	Crenate throughout their length	Narrower in section than the medulla	Without medulla or with only a small medulla	—

(Continued from page 1)

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